
Virginia Rich

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RESEARCH INTERESTS

I am interested in understanding the dynamic link between microbial community ecology and global biogeochemistry. In my thesis work I am applying a novel microarray platform to track the changes in marine microbial communities across environmental gradients, in concert with metagenomics analyses, and have previously examined changes in terrestrial methane-oxidizing microbial communities under simulated global change conditions. My goal is to continue to map these complex interactions, since we remain far from understanding their baseline conditions. In addition, I'd like to incorporate a personal or collaborative emphasis on modelling, prediction and potential remediation opportunities.

EDUCATION

Massachusetts Institute of Technology, Joint Program with the Woods Hole Institute of Oceanography

Ph.D. candidate, expected completion date March 2008

Co-advisors: Ed DeLong, MIT, and George Somero, Stanford

Committee members: Martin Polz, MIT, Sonya Dyhrman, WHOI

University of California at Berkeley

B.A. Molecular and Cell Biology, emphasis Genetics

B.A. Integrative Biology

PUBLICATIONS

Rich, V, DeLong EF. A "genome proxy" oligonucleotide microarray for marine microbial ecology. *Manuscript in preparation*.

Preston, CM, Suzuki M, **Rich V**, Heidelberg J, Chavez F, DeLong EF. Detection and distribution of two novel form II RuBisCos in the Monterey Bay. *Manuscript in preparation*.

DeLong EF, Preston CM, Mincer T, **Rich V**, Hallam SJ, Frigaard NU, Martinez A, Sullivan MB, Edwards R, Brito BR, Chisholm SW, Karl DM. 2006. Community genomics among stratified microbial assemblages in the ocean's interior. *Science*. 311:496-503.

Horz, H-P, **Rich V**, Avrahami S, and Bohannon BJ. 2005. Methane-oxidizing bacteria in a California upland grassland soil: diversity and response to simulated global change. *Applied and Environmental Microbiology*. 71(5): 2642-2652.

POST-BACCALAUREATE RESEARCH EXPERIENCE

Massachusetts Institute of Technology, and the Monterey Bay Aquarium Research Institute (MBARI), DeLong Lab

Graduate Student, 01/04 – present

Question: How do marine microbial communities change across environmental gradients of light, temperature, and nutrients?

1st Approach: To enable higher-throughput tracking of marine microbes, I developed a novel microarray platform targeting uncultivated, dominant microbes in environments of interest. I am currently applying this array to understanding seasonal and depth distributions of marine microbial communities in Monterey Bay, CA, where there is an associated long-term physical-, chemical- and biological- monitoring program run by MBARI. This work represents the current focus of the Monterey Bay Microbial Observatory.

Findings: This microarray is able to track clusters of micro-organisms within >85% average nucleotide identity of those targeted, with a current limit of detection of 1000 cells/ml seawater. Microarray signal is linearly related to target cell concentration with an R^2 of 0.999 across six orders of magnitude. The first manuscript is in preparation.

2nd Approach: As part of a large collaborative effort to explore metagenomics data from microbial communities through the water column at the Hawai'i Ocean Time Series Station ALOHA, I examined the depth distribution of specific marine microbes.

Findings: Pelagic microbial communities are stratified with depth; the complements of organisms and of metabolic genes are differentially distributed through the water column. This work was published in *Science*.

Stanford University, Hopkins Marine Station, Somero Lab

Rotating Graduate Student 1/04 – 7/04

Question: What microarray protocols for target amplification are best suited to novel array applications?

Approach: I learned microarray techniques on PCR-product expression arrays that target the ecophysiology of gobies, in order to adapt these techniques to the creation of a marine microbial microarray platform.

Findings: Linear Klenow-based amplification and labelling of targeted DNA is a robust method but may not allow sufficient amplification from small environmental samples.

Stanford University, Bohannon Lab

Rotating Graduate Student 1/03 – 12/03

Question: How does simulated global change effect grassland microbial communities?

Approach: We examined methane oxidizers at the Jasper Ridge Global Change Experiment (a national Long-Term Ecological Research site), through the particulate methane mono-oxygenase gene, and by measuring of *in situ* methane concentrations. Molecular evolutionary analyses helped map the potential functional constraints and selective pressures that gave rise to several novel clades.

Findings: Type II methanotrophs and three novel clades of potential methane-oxidizing microbes were identified at this site, whose lineages responded differently to multifactorial global change conditions. This work was published in *Applied and Environmental Microbiology*.

Univ. of Washington at Seattle's Friday Harbor Labs, Center for Cell Dynamics

Research Associate, 10/01 – 12/02

Question: How do gene networks control early pattern formation in metazoan development?

Approach: I tracked specific proteins using immunofluorescence confocal microscopy, time-lapse fluorescence microscopy of GFP-mutants, and computer-intensive image processing.

Findings: Movies and 3-D confocal stacks of segment polarity gene expression, particularly of the *engrailed* gene in *Drosophila* embryos, assisted the Center's investigations into comparative metazoan development.

Monterey Bay Aquarium Research Institute, DeLong Lab

Collaborating Scientist 9/01 – 12/01, Intern 6/01 - 8/01

Question: How does autotrophy vary with depth through the water column?

Approach: I screened the lab's large-insert environmental genomic libraries and DNA depth profiles for functional genes.

Findings: A novel monophyletic group of Form II RuBisCO was identified in the 750m Monterey Bay BAC library, representing potentially unknown autotrophy in the oxygen minimum zone. The manuscript is in preparation by the lead author.

University of Washington at Seattle's Friday Harbor Labs

Research Apprentice with Dr. Scott Edwards, 9/99 - 12/99

Question: What are the evolutionary origins of the multigene families involved in the innate immune response?

Approach: I looked for the complement component 3 gene in basal deuterostomes and protostomes, combining field and molecular biology work. DNA from twenty-six marine species across nine phyla was extracted and used for both PCR and Southern blotting.

Findings: Optimized protocols were developed for working with this extremely diverse array of source organisms.

TEACHING EXPERIENCE

University of Washington at Seattle's Friday Harbor Labs

Lecturer and Teaching Associate

Research Apprenticeship on *Acetabularia* Morphogenesis and Development (led by Drs. Garry Odell and Dina Mandoli), 9/00 – 12/00, 1/02 – 6/02

Description: I designed and gave the lectures for the molecular biology portion of the apprenticeship, and designed and led many of the labs, while helping mentor students in their independent research projects. <http://courses.washington.edu/dmandoli/FHL.html>

Honor: Our first apprenticeship received the best reviews of any at FHL. Our team returned the following year to offer a second iteration of the apprenticeship.

University of Washington at Seattle

Teaching Associate and Assistant Lab Coordinator

Biology 201, 3/01 - 6/01, 1/00 - 6/00

Description: I taught multiple laboratory sections each quarter covering the genetics and biochemistry portion of the University's introductory biology course; in the second year I helped coordinate the labs as well as teach them.

Teaching Associate

Biochemistry 442, 3/00 - 6/00

Description: I taught the discussion section of an upper division biochemistry course, and performed the general administrative work required for the running of the course.

Independent Vendor for the Washington State Department of Social and Health Services, Division of Vocational Rehabilitation

Tutor, Invertebrate Zoology 1/00 - 3/00 and Animal Diversity 3/00 - 6/00

Description: I tutored a learning-disabled University of Washington student.

RESEARCH CRUISES

R/V Point Lobos, MBARI, 6/01, 3/04, 4/04, 5/04: Microbial DNA archiving cruises.

R/V Western Flyer, MBARI, 7/01: Mid-water ecology cruise led by the Robison Lab.

R/V Thomas G. Thompson, Univ. of Washington, 12/00: Puget Sound Regional Synthesis Model (PRISM) cruise.

UNDERGRADUATE RESEARCH EXPERIENCE

Gump Research Station, Moorea, French Polynesia, 10/98 - 12/98

Independent Research: Performed a physical and biological survey of the benthos in two tropical Pacific bays to a depth of 40m, comparing a more developed bay with a relatively pristine one.

University of California at Berkeley, 7/97 - 4/98

Independent Research: Investigated the effects of predator exclusion on benthic community structure at a site in northern Maine.

University of California at Berkeley, Caldwell Lab, 9/96 - 2/97

Laboratory Assistant: Helped maintain the lab's stomatopods and octopods.

Marine Ecotoxicology Group, Richmond Field Station, U.C. Berkeley, 9/96 - 2/97

Laboratory Assistant: Sorted invertebrate infauna from marine benthic samples, with field sampling and gut juice extraction duties.

University of California at Berkeley, Chapin Lab, 5/96 - 8/96

Field and Laboratory Assistant: Assisted in plant and soil ecological investigations at Stanford's Jasper Ridge LTER site and at the University of Minnesota's Cedar Creek LTER site, and processed samples in the lab.

College of the Atlantic, Bar Harbor, Maine, 2/95 - 5/95

Independent Research: Compared species diversity in an intertidal bedrock community in northern Maine ten years after the cessation of direct coastal sewage release to a survey at the same site done by the Bigelow Laboratory in 1978.

SCIENTIFIC CONFERENCES ATTENDED

- The 11th International Symposium on Microbial Ecology, 8/06, Vienna, Austria
- The 3rd Microbial Observatories and Microbial Interactions and Processes Program Principal Investigators' Workshop, 9/04, Bozeman, Montana
- The ASLO Ocean Sciences 2004 Meeting, 2/04, Honolulu, Hawai'i
- The 10th Deep Sea Biology Symposium, 8/03, Oregon Institute for Marine Biology
- The ASLO Ocean Sciences 2002 Meeting, 2/02, Honolulu, Hawai'i
- The 1st International Symposium on Deep Sea Corals, 8/00, Halifax, Nova Scotia
- The 9th Deep Sea Biology Symposium, 6/00, Galway, Ireland
- The 8th Deep Sea Biology Symposium, 9/97, Monterey, California

SERVICE & OUTREACH

Journal Club Co-Founder and -Organizer, MIT, 09/05 – present: Co-founded a journal club on current issues in microbial ecology.

Workshop Organizer, MIT, 10/06: Organized a two-day workshop for graduate and postdoctoral women scientists to improve the retention of women in academic science, in collaboration with Dean Blanche Staton (bestaton@mit.edu). The workshop received very positive reviews and will be repeated in 2007.

Mini-symposium Co-Organizer, Earth Systems Initiative, Microbial Systems Group, MIT, 06/06: Co-organized the first symposium for the nascent Microbial Systems Group at MIT.

Seminar Series Co-Organizer, MIT, 01/06 – 05/06: Organized several seminars in a community-organized series for women in science.

Invited Guest Lecturer, MBARI, 8/01: Lectured to the visiting NASA-Ames Astrobiology Academy on microbiology research at MBARI.

Invited Guest Lecturer, MBARI, 7/01: Lectured to the visiting Bay Area Schools for Excellence in Education teacher group on fostering excitement in science education.

REFERENCES

Dr. Edward DeLong, Professor at the Massachusetts Institute of Technology, delong@mit.edu

Dr. George Somero, Director of Hopkins Marine Station, Stanford University, somero@stanford.edu

Dr. Brendan Bohannon, Professor, Center for Ecology and Evolution, University of Oregon at Eugene, bohannon@uoregon.edu

Dr. Garrett Odell, Director of the Center for Cell Dynamics, Friday Harbor Labs, University of Washington at Seattle, odellgm@u.washington.edu